The latter line is seen only in the absence of manganese, as it very nearly coincides with one of the group of strong manganese lines; it is, therefore, obscured in the spectra of the Bessemer flame and of the crude iron.

The oxide of gallium was separated as far as possible from all other substances and heated in the oxy-hydrogen flame and the characteristic spectrum was then photographed from this oxide.

3. *Evidence from the Roasted Ore, and substances separated therefrom.*

The roasted Cleveland ore was heated alone for thirty-five minutes in the oxy-hydrogen flame, it gave only a very faint indication of one line in the spectrum of gallium. The solution extracted from the ore by digesting it with warm dilute hydrochloric acid of double normal strength, when boiled with ammonium acetate gave a precipitate, the spectrum of which contained the line 4171·6 *fairly strong.*

The silicious residue insoluble in *strong* hydrochloric acid, when decomposed by fusion with caustic potash and subsequent boiling with water, after concentration of the solution so as to retain the gallium, gave a spectrum containing both lines, 4171·6 and 4032·7. All other elements had been removed.

The wave-lengths given are on Rowland's scale. The lines were measured on many plates and also repeatedly on the same plate, the results being the same in each case.

"The Electromotive Properties of the Electrical Organ of *Malapterurus electricus.*" By FRANCIS GOTCH, M.A. (Oxon.), F.R.S., and G. J. BURCH, M.A. (Oxon.). Received April 2,—Read May 7, 1896.

(Abstract.)

The experiments were made upon six specimens of *Malapterurus electricus*, 12 to 15 cm. in length, brought from the River Senegal by Mr. A. Ridyard (ss. " Niger "), and generously placed at the disposal of the authors by the Liverpool Corporation Museum Committee, to whom and to Dr. Forbes, the Director of the Museum, the authors desire to express their thanks.

Three of the specimens were killed, in order to carry out experiments upon the isolated organ. The instrumental methods employed by the authors for determining for the first time the characters and time relations of the activity of the organ response were chiefly the following :—

(*a.*) The record of the frog nerve muscle galvanoscope.

(*b.*) The galvanometer connected with a suitable rheotome.

(c.) The capillary electrometer, a large number (about 250) photo-graphic records being taken of the movements of the meniscus. Facsimile reproductions of typical records are given in the fuller communication.   The electrometer was used either shunted by a resistance of from 80 to 100 ohms, or in connection with the outer plates of a special condenser, the inner plates of which were con-nected with the fish or its electrical organ.

The organ responded to mechanical or electrical excitation of its nerves after removal from the fish, the response being unaffected by 1 per cent. curare, or 1 per cent. atropine solution.   No response could be evoked by such chemical agents as sodium chloride, gly-cerine, or weak acid, when applied either to the organ or its efferent nerve.

The conclusions drawn by the authors from the experiments on the isolated organ and on the entire uninjured fish may be summarised as follows :—

(1) The isolated organ responds to electrical excitation of its nerves by monophasic electromotive changes, indicated by electrical currents which traverse the tissue from the head to the tail end ; this response commences from 0·0035″ at 30° C. to 0·009″ at 5° C. after excitation, the period of delay for any given temperature being tolerably constant.

(2) The response occasionally consists of a single such monophasic electromotive change (shock) developed with great suddenness, and subsiding completely in from 0·002″ to 0·005″, according to the tem-perature ; in the vast majority of cases the response is multiple, and consists of a series of such changes (shocks) recurring at perfectly regular intervals, from two to thirty times (peripheral organ rhythm) ; the interval between the successive changes varies from 0·004″ at 30° C. to 0·01″ at 5° C., but is perfectly uniform at any given tempera-ture throughout the series.

(3) Such a single or multiple response (in the great majority of cases the latter) can also be evoked by the direct passage of an induced current through the organ and its contained nerves, in either direc-tion heterodromous (i.e., opposite in direction to the current of the response) or homodromous.

(4) The time relations of the response are almost identical whether this is evoked by nerve-trunk (indirect) stimulation, or by the passage of the heterodromous induced current.

(5) There is no evidence that the electrical plate substance can be excited by the induced current apart from its nerves, i.e., it does not possess independent excitability.

(6) The organ and its contained nerves respond far more easily to the heterodromous than to the homodromous induced current, and the period of delay in the case of the latter response is appreciably lengthened.

(7) The peripheral organ rhythm (multiple response) varies from about 100 per second at 5° C. to about 280 per second at 35° C.

(8) One causative factor in the production of the peripheral rhythm is the susceptibility of the excitable tissue to respond to the current set up by its own activity (self excitation). .

(9) In the uninjured fish mechanical or electrical excitation of the surface of the skin beyond the limits of the organ evokes a reflex response with a long delay (0·03″ to 0·3″) ; this reflex response consists of groups of shocks, each group showing the peripheral organ rhythm, but separated from its neighbour by a considerable interval of time (reflex or central rhythm).

(10) In the uninjured fish electrical excitation of the skin over the organ evokes a response which may consist of a direct peripheral organ effect followed by such a reflex effect.

(11) The minimal total reflex delay at 20° C. is 0·023″, giving a central excitatory time of about 0·01″.

(12) The reflex or central rhythm in our specimens showed a maximum rate of 12 per second and an average rate of from 3 to 4 per second.

(13) The number of separate groups in the reflex response recurring at the intervals mentioned in the preceding paragraph was in our fish limited to from 2 to 5.

(14) The E.M.F. of each single change in the organ response depends upon the number of effective plates with their nerves, and in 10 cm. of excited organ cannot possibly be less than 75 volts, and is probably much nearer 150 volts. As in our specimens the number of plates in series in 1 cm. of organ was 180, this gives a minimal possible E.M.F. of 0·04 volt, and a probable E.M.F. of 0·07 volt for each plate.

The authors further conclude that, since each lateral half of the organ is innervated by the axis cylinder branches of one efferent nerve cell, and has no independent excitability, the specific characters of the reflex response of the organ express far more closely than those of muscle the changes in central nerve activity, and are presumably those of the activity of a single efferent nerve cell.

The single efferent nerve cell, the activity of which is thus for the first time ascertained, shows—

(*a.*) A minimum period of delay of 0·008″ to 0·01″.

(*b.*) A maximum rate of discharge of 12 per second.

(*c.*) An average rate of discharge of 3 to 4 per second.

(*d.*) A susceptibility to fatigue showing itself in the discharge failing after it had recurred from two to five times at the above rates.